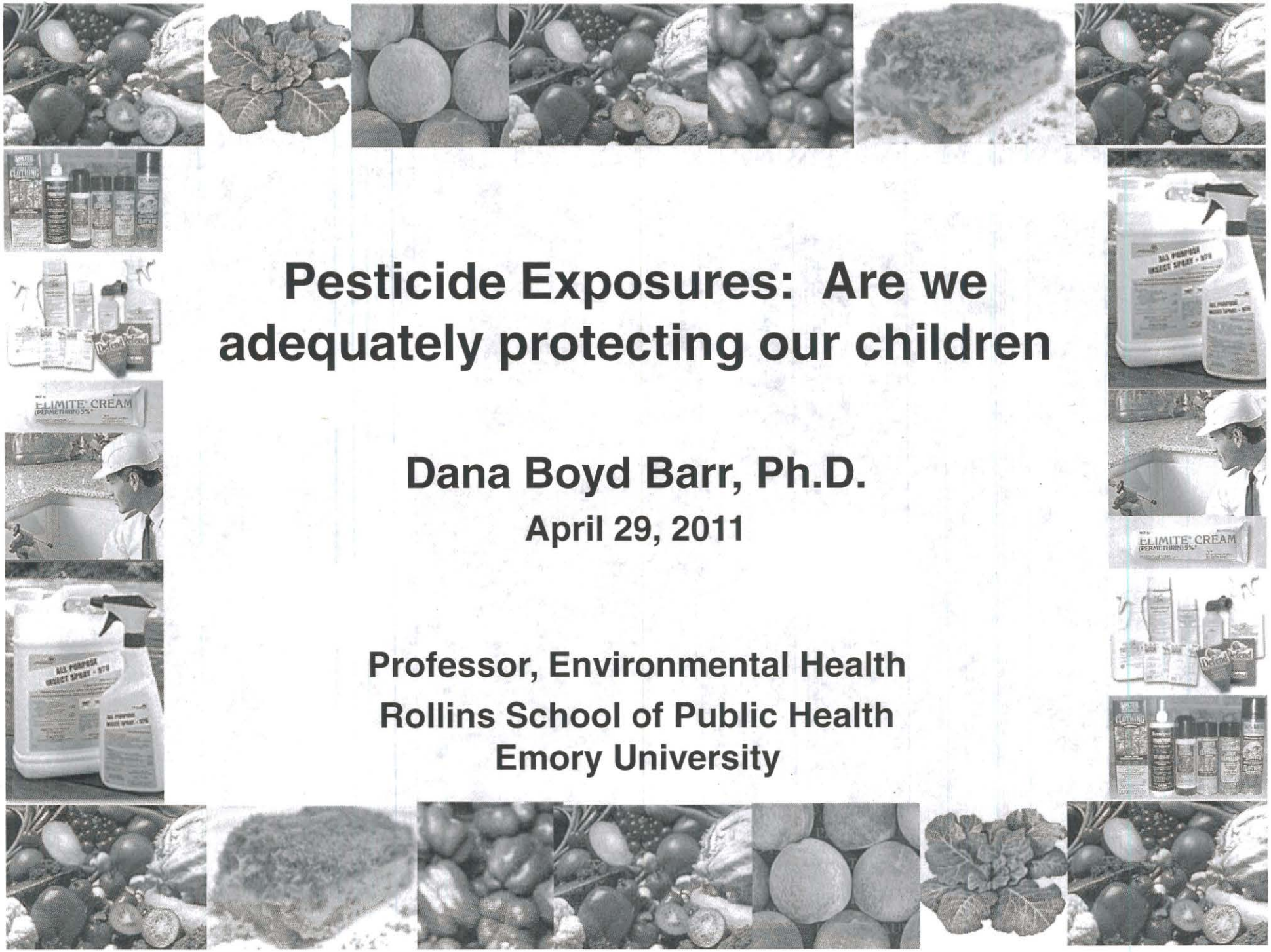


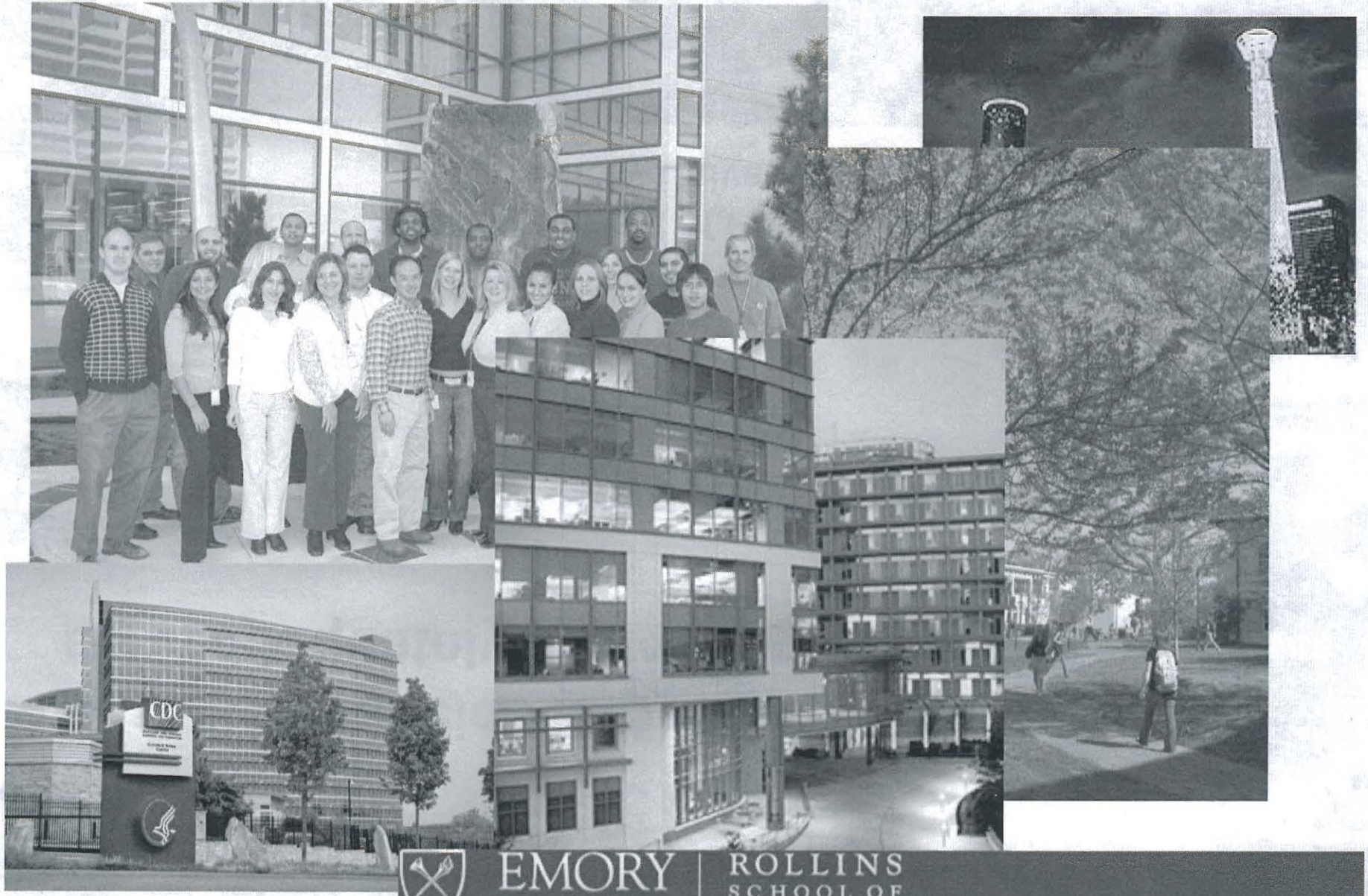
Pesticide Exposures: Are we adequately protecting our children

Dana Boyd Barr, Ph.D.

April 29, 2011

Professor, Environmental Health

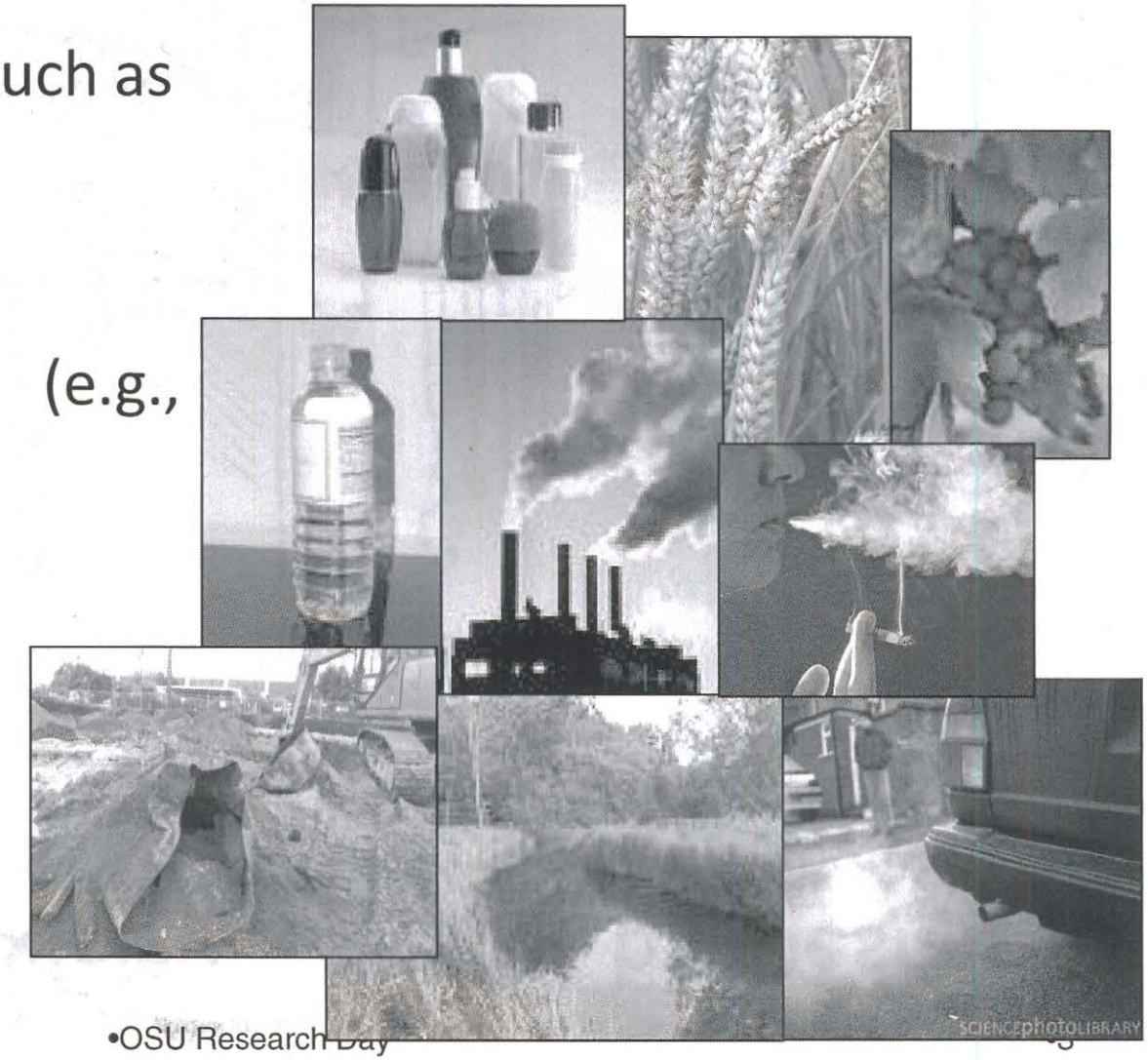
Rollins School of Public Health
Emory University



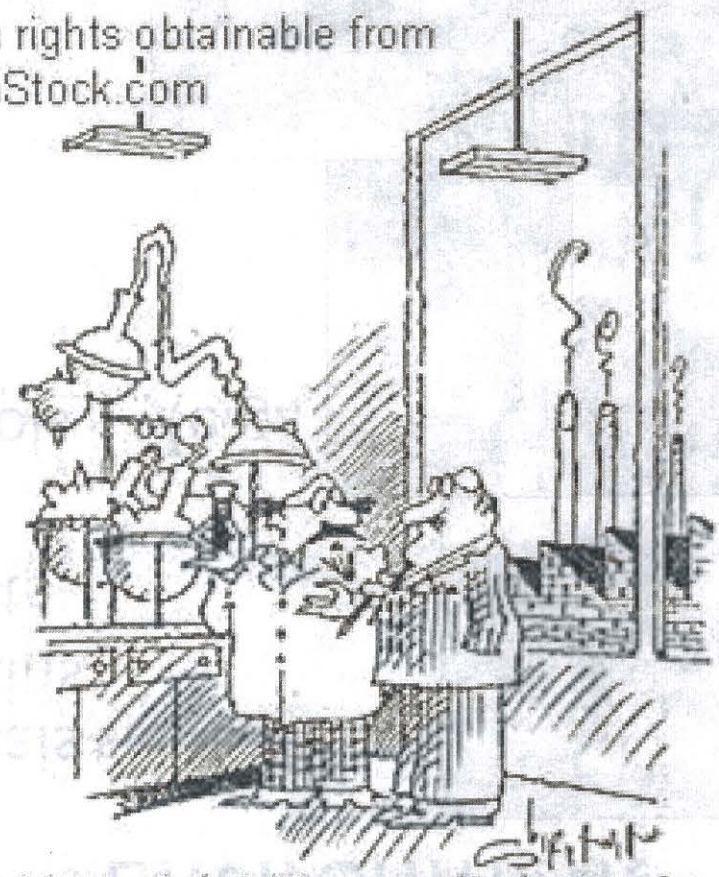
EMORY | ROLLINS SCHOOL OF PUBLIC HEALTH

Chemicals Are Pervasive in the Environment

- Banned chemicals such as DDT, PCBs, dioxins
- Flame retardants
- Phthalates
- Alkylated phenols (e.g., BPA)
- ETS and PAHs
- Perchlorate
- Pesticides



Pesticide Toxicity – Lethal by Design



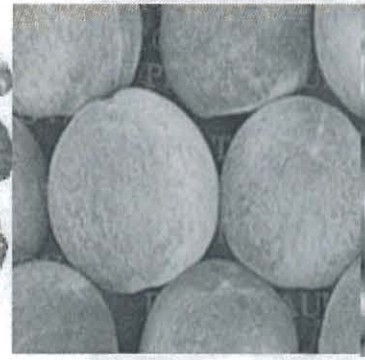
"As we had hoped, it kills weevils instantly. It also kills blue birds, snow geese, ground hogs,manatees, butterflies,swordfish and Alaska king crabs. Will that be a problem?"

Pesticides are Covenient

"Oh no, Daisy's committing herbicide!"

Pesticides are Critical Public Health Tools





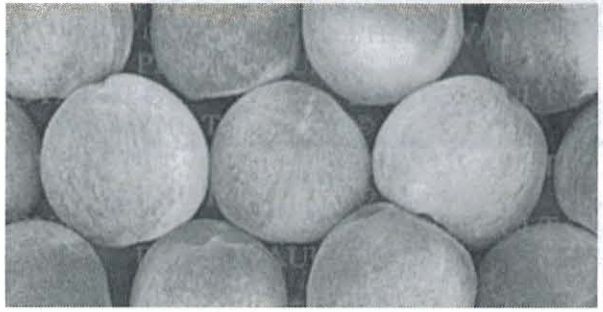

Pesticides are Easy to Obtain

Pesticides Are Everywhere










Key Exposure Pathways - Non Occupational

Diet is the baseline

Followed by sporadic exposures from other/household uses

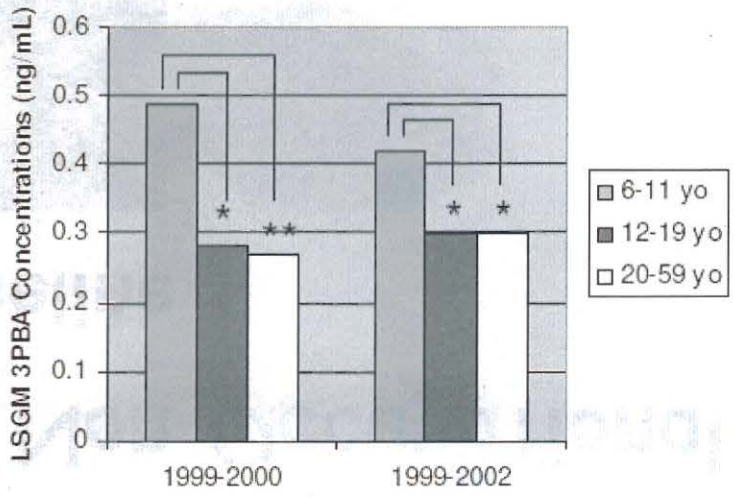
Pesticides are in (most of) our bodies (esp. children)

	Survey years	Geometric mean (95% confidence limit)	Selected percentile (95% confidence interval) 50th	75th	90th	95th	Weighted Sample size	Detection Percent
Age group								
6-11 years	99-00	0.417 (0.292-0.595)	0.320 (0.210-0.490)	10.12 (0.700-1.60)	4.18 (2.02-6.54)	8.63 (3.89-71.1)	483	71.9
	01-02	0.325 (0.260-0.406)	0.300 (0.200-0.420)	0.760 (0.570-1.05)	1.81 (1.42-2.78)	3.38 (2.25-4.12)	580	75.2
12-19 years	99-00	0.336 (0.265-0.427)	0.290 (0.200-0.440)	0.870 (0.620-1.04)	1.93 (1.49-2.90)	4.33 (1.83-11.1)	682	73.2
	01-02	0.353 (0.288-0.434)	0.300 (0.250-0.390)	0.800 (0.560-1.13)	1.86 (1.48-2.35)	3.45 (2.14-6.69)	831	79.8
20-59 years	99-00	0.267 (0.227-0.314)	0.230 (0.160-0.300)	0.640 (0.510-0.820)	1.49 (1.25-1.78)	3.21 (2.04-5.41)	833	64.2
	01-02	0.314 (0.271-0.364)	0.270 (0.220-0.340)	0.670 (0.530-0.780)	1.65 (1.27-2.34)	3.25 (2.51-6.16)	1128	75.8
60+ years	01-02	0.303 (0.233-0.394)	0.250 (0.180-0.350)	0.690 (0.490-1.10)	2.03 (1.45-3.68)	5.16 (2.77-6.61)	509	70.3
	01-02	0.372 (0.301-0.462)	0.320 (0.240-0.410)	0.730 (0.540-1.02)	2.16 (1.28-3.50)	4.06 (2.44-6.15)	508	70.3

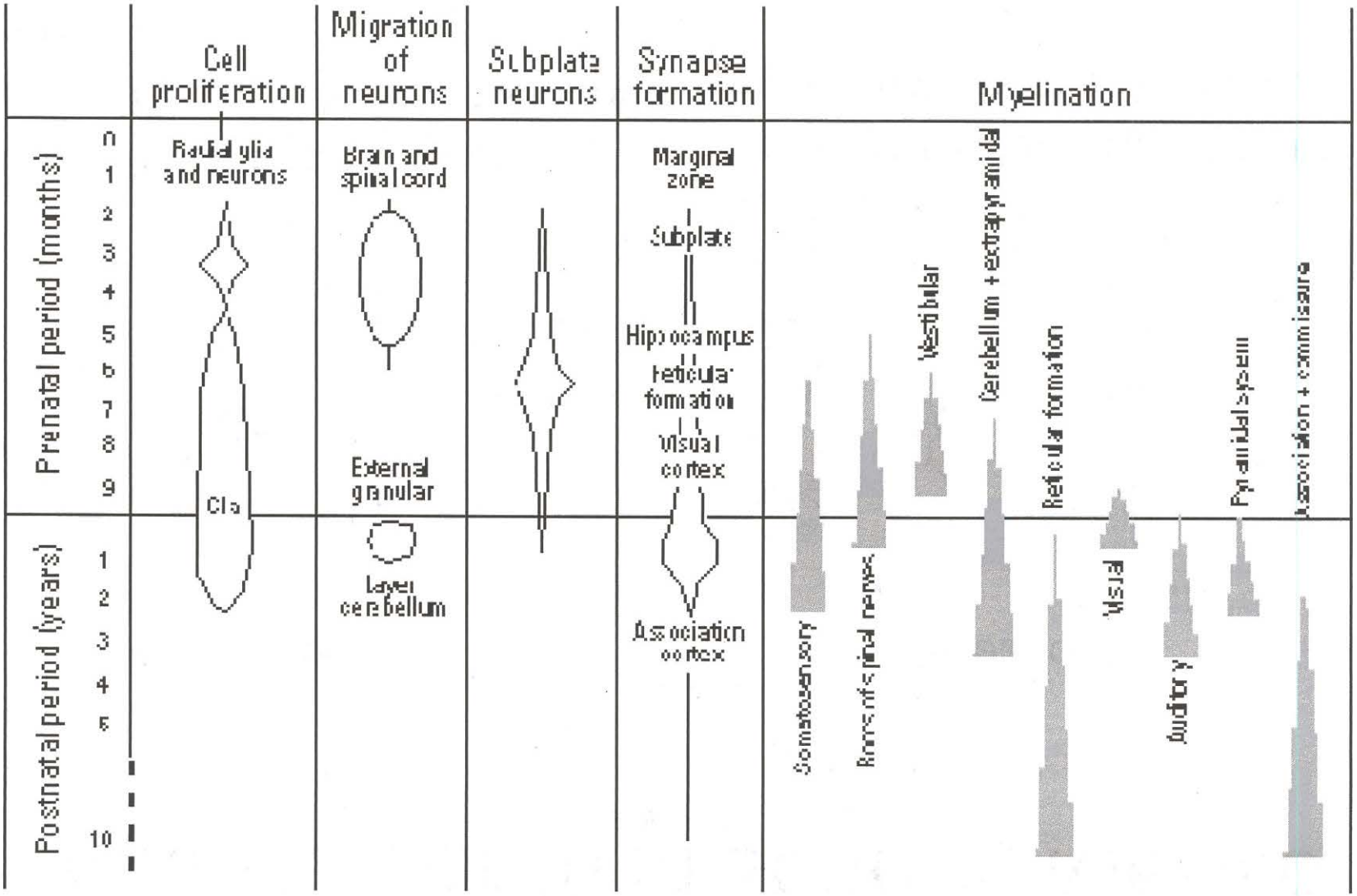
Urinary concentrations of 3-phenoxybenzoic acid (3PBA) acid (ng/mL) in the general U.S. population, NHANES 1999-2002

(modified from Table 2, Barr *et al.* 2010. *Environ Health Perspect* Epub 3 Feb.

Barr *et al.* 2010. Fig. 3



Why do we care?

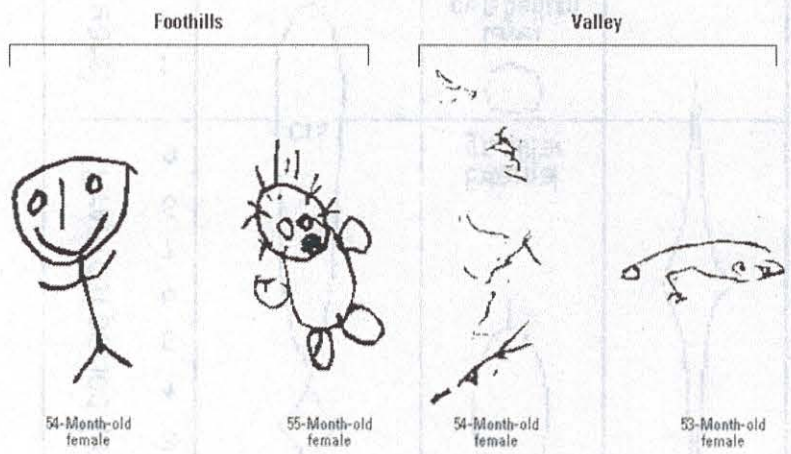


•Fig 2 in **Critical periods of vulnerability for the developing nervous system**

• *Environ Health Perspect* 108:511-33.

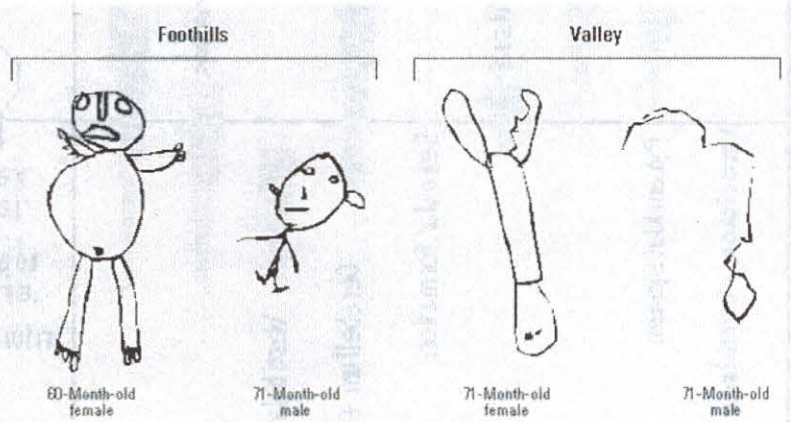
Yaqui Children in Sonora, Mexico

4-year olds



Valley children had decreased stamina, motor skills, and cognitive development

5-year olds



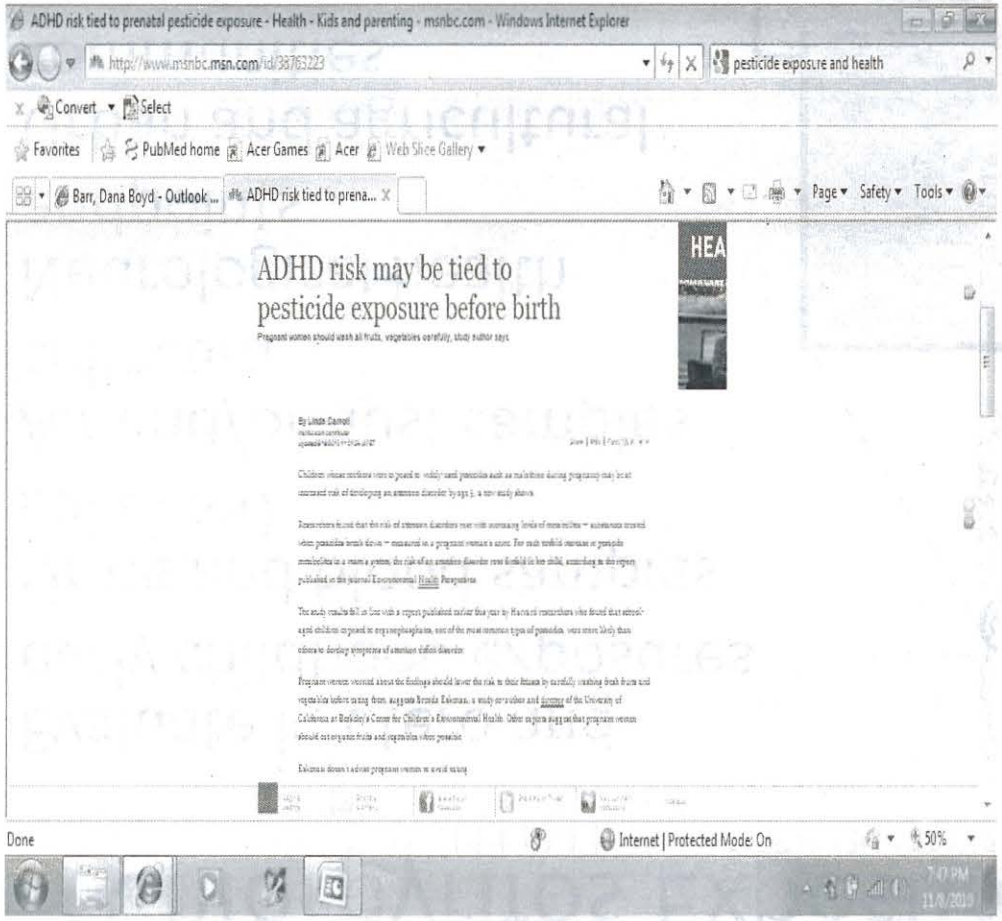
Foothill and valley children differed only in local use of pesticides

Guillette et al., EHP 106(6):347-53 (1998).

Three US Birth Cohorts Investigating Chlorpyrifos Exposure and Health

- Evaluate in utero and early childhood exposures
- Urine and blood samples collected
- Air and/or dust samples collected
- Neurological health endpoints
- Urban and agricultural communities
- Multiple exposure measures

Neurological Delays Found in All Three Studies



Rauh et al. Pediatrics;118(6):e1845-59 (2006).

http://www.msnbc.msn.com/id/38763223

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Impact of Prenatal Chlorpyrifos Exposure on Neurodevelopment in the First 3 Years of Life Among Inner-City Children
Virginia A. Rauh, Robin Garfinkel, Frederica P. Perera, Howard F. Andrews, Lori Hoepner, Dana B. Barr, Ralph Whitehead, Deliang Tang and Robin W. Whyatt
Pediatrics 2006;118;e1845-e1859; originally published online Nov 20, 2006;
DOI: 10.1542/peds.2006-0338

Research | Children's Health

Organophosphate Pesticide Exposure and Neurodevelopment in Young Mexican-American Children

Brenda Eskenazi,[1] Amy R. Marks,[1] Asa Bradman,[1] Kim Harley,[1] Dana B. Barr,[2] Caroline Johnson,[1] Norma Morga,[3] and Nicholas P. Jewell[1]

[1]Center for Children's Environmental Health Research, School of Public Health, University of California, Berkeley, California, USA; [2]National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA; [3]Center for the Health Assessment of Mothers and Children of Salinas, Clínica de Salud del Valle de Salinas, Berkeley, California, USA

Research | Children's Health

Neurobehavioral Deficits and Increased Blood Pressure in School-Age Children Prenatally Exposed to Pesticides

Raul Harari,[1] Jordi Julvez,[2] Katsuyuki Murata,[3] Dana Barr,[4] David C. Bellinger,[2,5] Frodi Debes,[6] and Philippe Grandjean[2,6]

[1]Corporación para el Desarrollo de la Producción y el Medio Ambiente Laboral, Quito, Ecuador; [2]Department of Environmental Health, Harvard School of Public Health, Boston, Massachusetts, USA; [3]Division of Environmental Health Sciences, Akita University, Akita, Japan; [4]National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA; [5]Department of Neurology, Children's Hospital, Boston, Massachusetts, USA; [6]Department of Environmental Medicine, University of Southern Denmark, Odense, Denmark

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Research | Children's Health

Organophosphate Pesticide Exposure and Attention in Young Mexican-American Children: The CHAMACOS Study

Amy R. Marks,[1] Kim Harley,[1] Asa Bradman,[1] Katherine Kogut,[1] Dana Boyd Barr,[2] Caroline Johnson,[1] Norma Calderon,[3] and Brenda Eskenazi[1]

[1]Center for Children's Environmental Health Research, School of Public Health, University of California, Berkeley, Berkeley, California, USA; [2]Emory University, Rollins School of Public Health, Atlanta, Georgia, USA; [3]Center for the Health Assessment of Mothers and Children of Salinas, Clínica de Salud del Valle de Salinas, Salinas, California, USA.

Pesticide Exposure and Stunting as Independent Predictors of Neurobehavioral Deficits in Ecuadorian School Children
Philippe Grandjean, Raul Harari, Dana B. Barr and Frodi Debes
Pediatrics 2006;117;e546-e556
DOI: 10.1542/peds.2005-1781

Outcome	Finding	Exposure Metric	Cohort
Birth Outcome			
• Length	Decrease	Maternal Blood CPF Maternal DAP/PON	NCY1 CHAMACOS
• Weight	Decrease	Maternal Blood CPF	NCY1
• Head Circumference	Decrease	Maternal DAPs/PON Maternal TCPY/PON	CHAMACOS NCY2
• Gestational Age	Decrease	Maternal DAPs/AChE	CHAMACOS
Neonatal Reflex	Abnormal	Maternal DAPs Maternal DAPs/PON	CHAMACOS
Cognitive Development @ 24 mo	Decreased	Maternal DAPs	CHAMACOS
Pervasive Development Disorder @ 3yrs	Increased	Maternal Blood CPF Maternal and Child DAPs	NCY1 CHAMACOS
Age at onset of ADHD	Decreased	Maternal Blood CPF	NY1
ADHD by age 5	Increased	Maternal DAPs	CHAMACOS
Cognitive development until aged 7 years	Decreased	Maternal Blood CPF Maternal Blood CPF Maternal DAPs/PON	CHAMACOS NYC2 NYC2
IQ	Decreased	Maternal Blood CPF Maternal Blood CPF Maternal DAPs/PON	CHAMACOS NCY1 NYC2

CDC's Fourth National Report on Human Exposure to Environmental Chemicals (1999-2004)

Urine

Metals

PAH metabolites

Phthalate metabolites

Pesticide metabolites

Phytoestrogens

Phenols

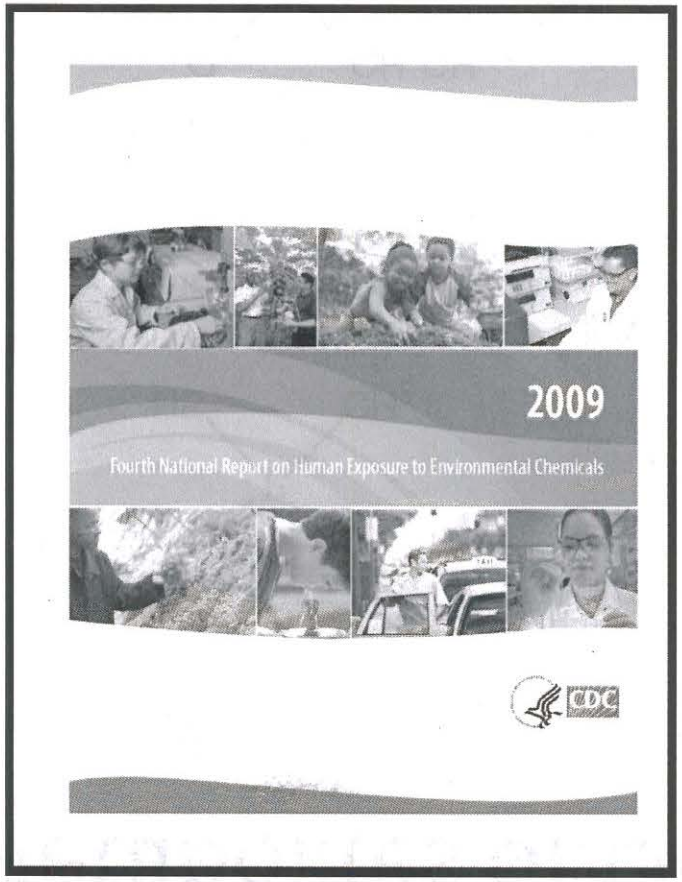
Perchlorate

Blood

Lead

Cadmium

Mercury



Released: December 2009

www.cdc.gov/exposurereport

Serum

Dioxins

Furans

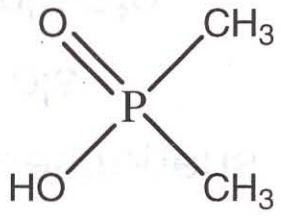
PCBs

Organochlorine pesticides

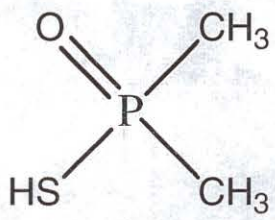
Cotinine

PFCs

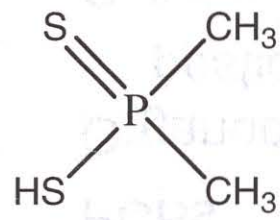
Common Metabolites of OP Pesticides



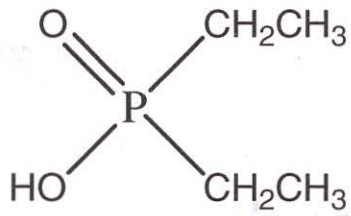
Dimethylphosphate



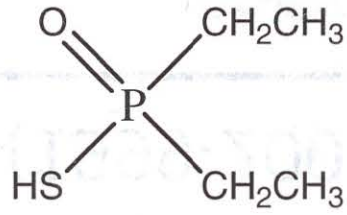
Dimethylthiophosphate



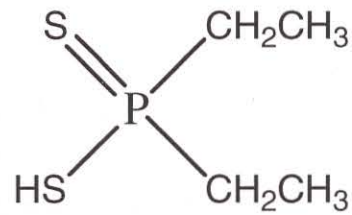
Dimethyldithiophosphate



Diethylphosphate



Diethylthiophosphate



Diethyldithiophosphate

PEDIATRICS
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Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)

Attention-Deficit/Hyperactivity Disorder and Urinary Metabolites of Organophosphate Pesticides

Maryse F. Bouchard, David C. Bellinger, Robert O. Wright and Marc G. Weisskopf

Pediatrics 2010;125;e1270-e1277; originally published online May 17, 2010;
DOI: 10.1542/peds.2009-3058

TABLE 5 ORs for Subtypes of ADHD for 10-Fold Increases in Urinary DAP Metabolite Levels ($N = 1139$)

	OR (95% CI)					
	Hyperactive/Impulsive Subtype ($n = 21$)		Inattentive Subtype ($n = 89$)		Combined Subtype ($n = 29$)	
	Unadjusted	Adjusted*	Unadjusted	Adjusted*	Unadjusted	Adjusted*
DEAPs	2.29 (1.25–4.21)	2.15 (1.06–4.40)	0.77 (0.52–1.14)	0.70 (0.49–1.01)	1.29 (0.69–2.43)	1.22 (0.59–2.50)
DMAPs	2.26 (1.33–3.86)	2.13 (1.08–4.20)	1.61 (1.10–2.37)	1.47 (0.99–2.19)	1.30 (0.56–2.99)	1.30 (0.49–3.49)
Total DAPs	1.95 (1.18–3.22)	1.85 (1.04–3.27)	1.26 (0.91–1.75)	1.14 (0.81–1.61)	1.09 (0.59–2.01)	1.05 (0.51–2.15)

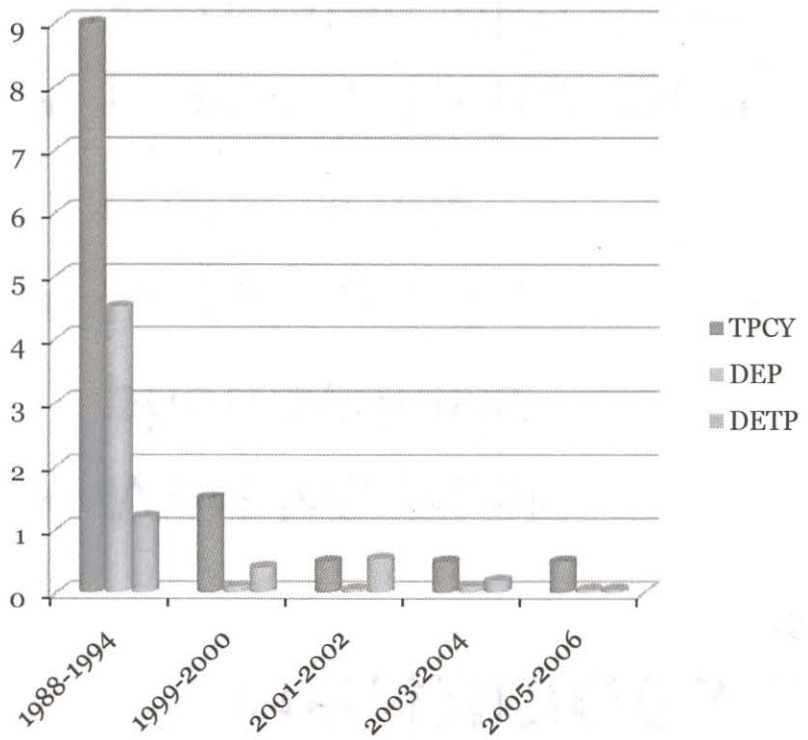
* Adjusted for gender, age, race/ethnicity, PIR, testing duration, and logarithmically transformed urinary creatinine concentration.

Even early childhood exposures to pesticides are linked to ADHD

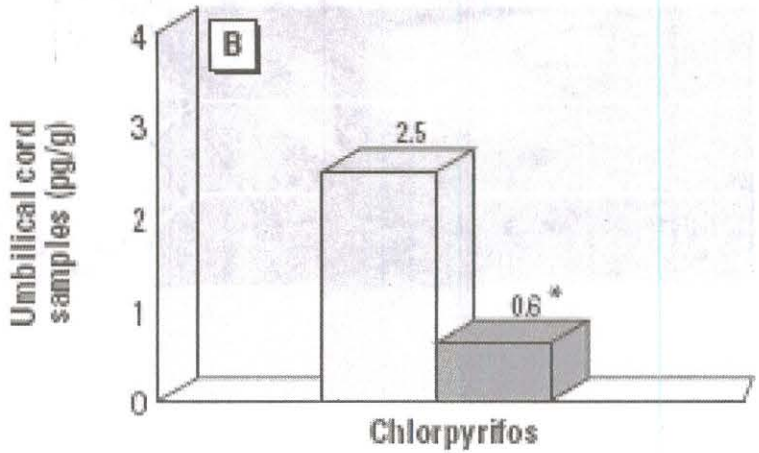
Bouchard et al.; Pediatrics;125(6):e1270-7 (2010).

Have US Regulatory Efforts Reduced OP Insecticide Exposure?

Absolutely



But Probably Not Enough



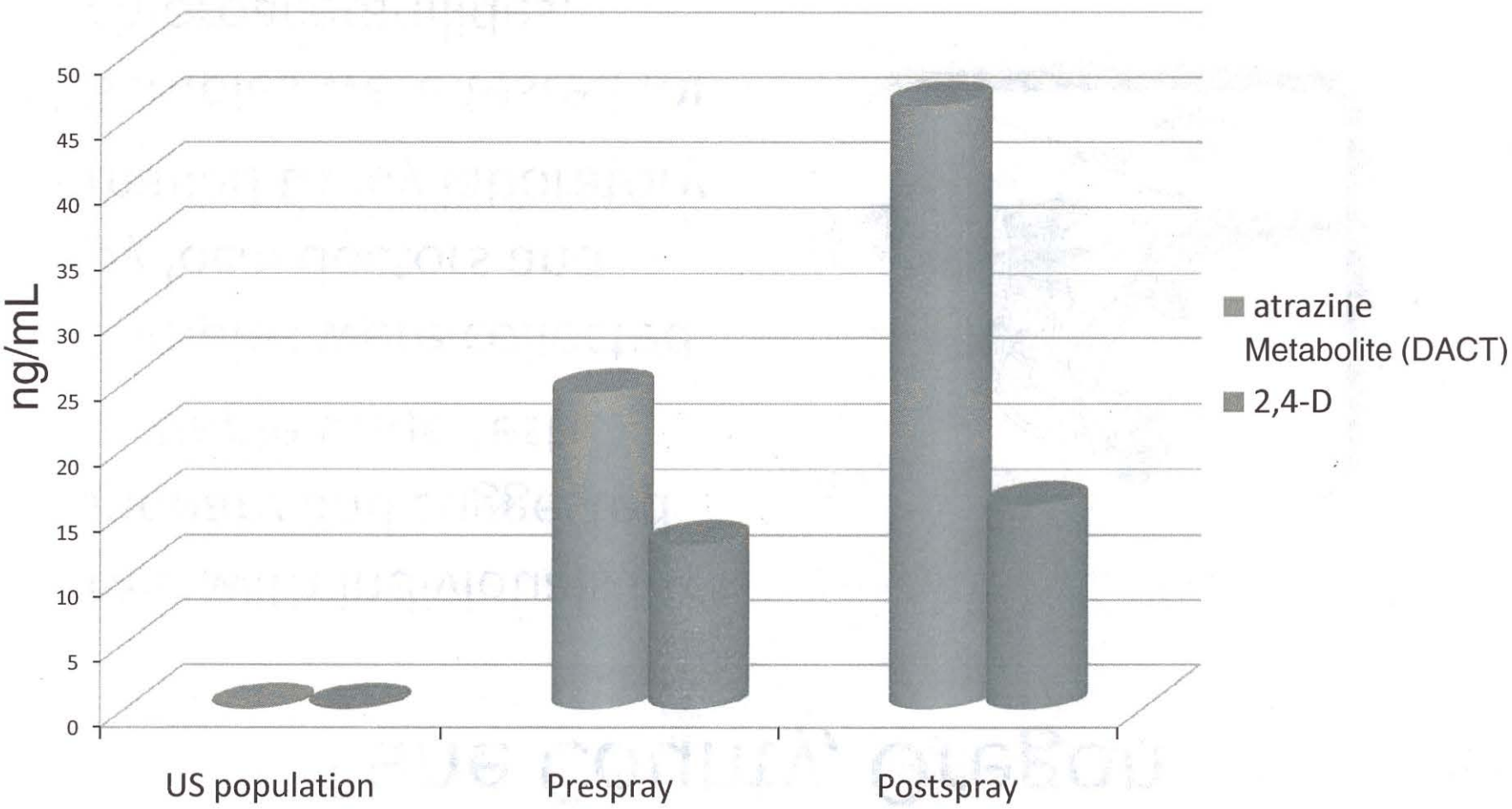
Herbicides … Another story

- Most interrupt photosythesis
- Largely used cosmetically
- Health outcome most associated with them are endocrine modulating effects

Lane County, Oregon

- Met with individuals in January and suggested a simple urine test
- Samples were collected by local doctors and mailed to my laboratory
- Samples were tested for chloroacetanilides, triazines and 2,4-D

Data suggest herbicide exposures

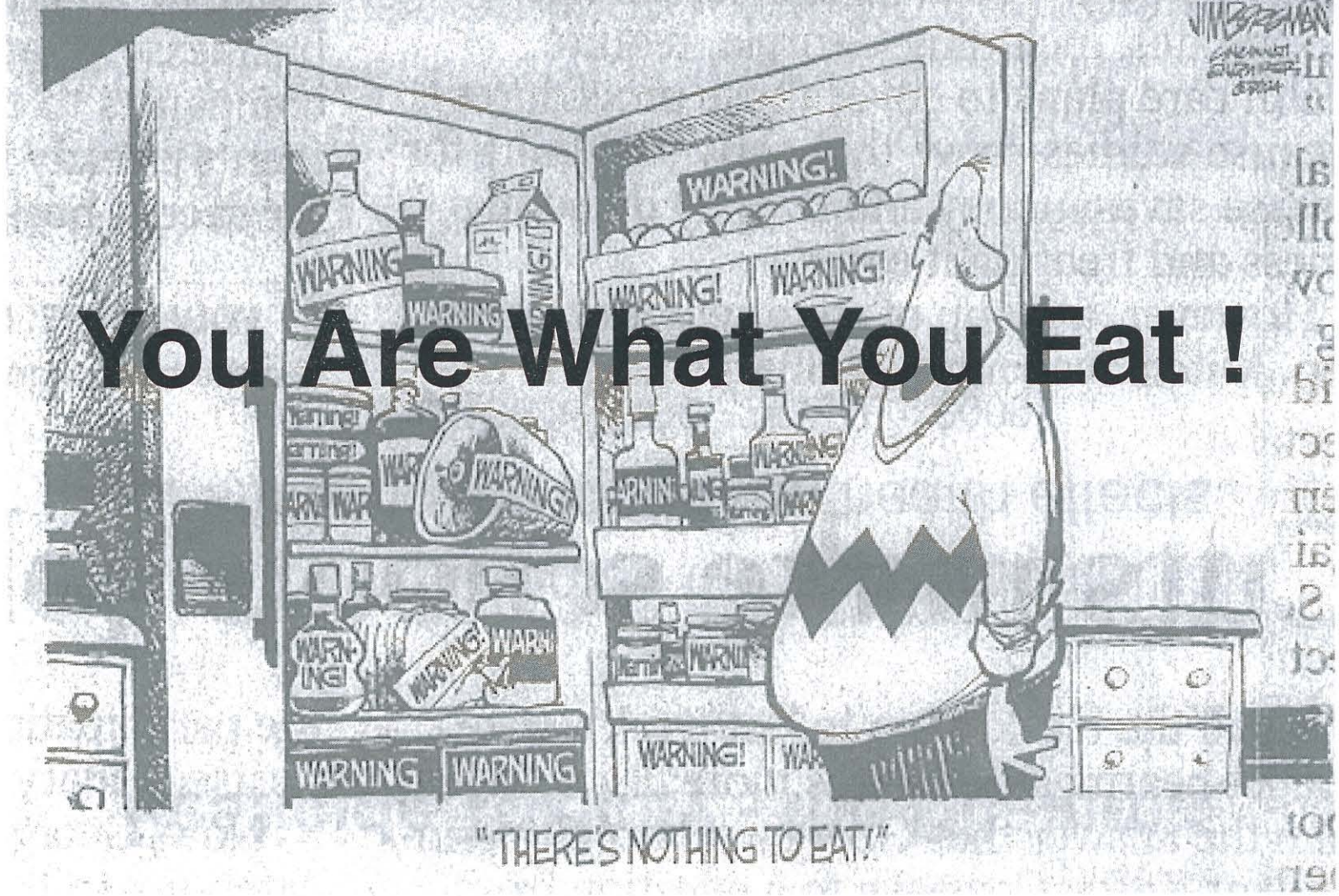


Pesticide Toxicity - the Dilemma

We are being used as the experimental rats for studying the long-term health effects of pesticide use. (Alex Lu, 2009)

Since we are all unique in our coexposures, comorbidities, lifestyle factors, and genetics, our experiment has an N of 1 with no controls and no possibility of replication.

JIM BORGMAN / *Cincinnati Enquirer*



You Are What You Eat !